CLAIMS

1. Process for preparing, by electrochemical reduction, a carbon-containing material whose surface is modified with organic groups, in particular functionalized organic groups, this process comprising placing the carbon-containing material in contact with an organic diazonium salt in solvent, optionally in the presence of an electrolyte, and negative polarization of the carbon-containing material relative to an anode which is also in contact with the solution of the organic diazonium salt or in contact with an electrolytic solution which is separate from the solution of the said salt, the said process being characterized in that the electrochemical reduction is carried out on an organic diazonium salt in protic solvent in acidic medium.

2. Process according to Claim 1, characterized in that the diazonium salt corresponds to the formula:

$$ArN_2^+X^- \quad (I)$$

in which:

Ar is a C_6-C_{14} aromatic residue optionally functionalized with one or more substituents or a heteroaromatic residue of 5 to 14 atoms, optionally functionalized with one or more substituents, comprising one or more hetero atoms chosen from oxygen, nitrogen, sulphur and phosphorus,

X^- is an anion.

3. Process according to Claim 2, characterized in that the substituents are chosen from the group consisting of:

- linear or branched aliphatic radicals optionally comprising one or more double or triple bond(s), optionally substituted with carboxyl, NO_2, disubstituted protected amino, monosubstituted protected amino, cyano, diazonium, alkoxy, alkoxycarbonyl, alkylcarbonyloxy or optionally fluorinated vinyl radicals or halogen atoms,

- aryl radicals optionally substituted with carboxyl, NO_2, disubstituted protected amino, monosubstituted protected amino, cyano, diazonium, alkoxy, alkoxycarbonyl, alkylcarbonyloxy or optionally fluorinated vinyl radicals or halogen atoms,

- carboxyl, NO_2, disubstituted protected amino, monosubstituted protected amino, cyano, diazonium, alkoxy, alkoxycarbonyl, alkylcarbonyloxy or optionally fluorinated vinyl radicals or halogen atoms.

4. Process according to Claim 3, characterized in that the said organic group is functionalized with one or more substituents capable of reacting directly with a substrate or with one or more precursor substituents which, after conversion, are capable of reacting with a substrate, the said substrate being chosen from the group consisting of organic resins, biological molecules, chemical molecules and complexing agents.

5. Process according to Claim 4, characterized in that the substituents capable of reacting directly with an organic resin are chosen from the group consisting of $-(CH_2)_n-COOH$, $-(CH_2)_n-CH_2-OH$ and $(CH_2)_n-NH_2$ groups, n being an integer between 0 and 10, and in that the precursor substituents capable of reacting, after conversion, with an organic resin are chosen from the group consisting of NO_2, N_2^+, $(CH_2)_n-CN$, $(CH_2)_n-CHO$ and $(CH_2)_n-COOPr$ groups, Pr being a protecting group, and $(CH_2)_n-NHP'r$, $(CH_2)_n-N(P'r)_2$ and $(CH_2)_n-N=P"r$ groups, P'r and P"r being protecting groups and n being an integer between 0 and 10.

6. Process according to Claim 4, characterized in that the substituents capable of reacting directly with a biological molecule are chosen from the group consisting of $(CH_2)_n-COOH$ and $(CH_2)_n-NH_2$ groups, n being an integer between 0 and 10, and in that the precursor substituents capable of reacting, after conversion, with a biological molecule are chosen from the group consisting of NO_2, N_2^+, $(CH_2)_n-CN$, $(CH_2)_n-CHO$ and $(CH_2)_n-COOPr$ groups, Pr being a protecting group and n being an integer between 0 and 10.

7. Process according to Claim 4, characterized in that the substituents capable of reacting directly with functional organic molecules are chosen from the group consisting of NO_2, $(CH_2)_n-CONH_2$, $(CH_2)_n-CN$, $(CH_2)_n-CHO$, $(CH_2)_n-COOH$, $(CH_2)_n-CH_2OH$ and $(CH_2)_n-NH_2$ groups, n being an integer between 0 and 10, and

SO_2H, SO_3H, SO_2R and SO_3R groups, R being an aliphatic or aromatic carbon-based chain of 1 to 20 carbon atoms and in that the precursor substituents capable of reacting, after conversion, with functional organic molecules are chosen from the group consisting of NO_2, $(CH_2)_n$-$CONH_2$ and $(CH_2)_n$-COOPr groups, Pr being a protecting group, and $(CH_2)_n$-NHP'r, $(CH_2)_n$-$N(P'r)_2$ and $(CH_2)_nN$=P"r groups, P'r and P"r being protecting groups, and $(CH_2)_n$-CN, $(CH_2)_n$-CHO, $(CH_2)_n$-COOH and $(CH_2)_n$-CH_2OH groups, n being an integer between 0 and 10, and SO_2Pr and SO_3Pr groups, Pr being a protecting group chosen from the meanings of R.

8. Process according to Claim 1, characterized in that the protic solvent is chosen from the group consisting of water, methanol and ethanol or mixtures thereof.

9. Process according to Claim 8, characterized in that the protic solvent is in a mixture with an aprotic solvent, it being understood that the mixture has the characteristics of an aprotic solvent.

10. Process according to Claim 1, characterized in that the acid is chosen from sulphuric acid, hydrochloric acid, nitric acid, nitrous acid, phosphoric acid and tetrafluoroboric acid.

11. Process according to one of Claims 1 to 10, characterized in that the pH of the solution is less than 2.

12. Process according to Claim 1,

characterized in that the reduction is carried out by repetitive cyclic voltammetry in a potential range in which the diazonium salts are reduced or by electrolysis at a potential which is more negative than the reduction potential of the diazonium salt.

13. Process according to Claim 1, characterized in that the diazonium salt concentration is between 10^{-3} and 10^{-1} mol/l.

14. Process for the electrochemical production of a carbon-containing material whose surface is modified with aromatic amino groups, according to one of Claims 1 to 13, characterized in that the aromatic diazonium salt is substituted with a nitro radical and in that the electrochemical reduction is maintained up to the reduction of the nitro radical into an amino radical.

15. Process according to one of Claims 1 to 14, characterized in that the carbon-containing material is in the form of fibres, powder, felt, fabric or carbon/carbon composite.

16. Process according to one of the preceding claims, characterized in that the modified carbon-containing materials are subjected to a subsequent conversion of the functional substituents.

17. Carbon-containing material modified at the surface with optionally functionalized organic groups, which can be obtained by the process according to one of Claims 1 to 16.

18. Material according to Claim 17, characterized in that it consists of carbon fibres or of a carbon-containing material in the form of powder or of a carbon-containing material in the form of felt, fabric, beads or carbon/carbon composite.

19. Composite material formed from an organic resin reinforced with fibres of carbon-containing material according to Claim 18, the surface of which has been modified with organic groups functionalized with substituents capable of reacting directly, or after conversion, with an organic resin.

20. Application of the materials according to Claim 17, at the surface of which are bound organic groups capable of reacting with a biological molecule of interest, for carrying out biological reactions.

21. Application of the materials according to Claim 17, at the surface of which are bound organic groups capable of reacting with a metal cation, with a functionalized organic molecule or a complexing agent, for carrying out such reactions.

22. Use of the process according to Claims 1 to 16, to make a combinatorial chemistry library of organic compounds.

23. Application of the materials according to Claim 17, at the surface of which are bound organic groups capable of reacting with functional organic molecules, to make a combinatorial chemistry library.

24. Application according to Claim 23, of

materials, at the surface of which are bound organic groups, characterized in that the said organic groups undergo one or more chemical and/or electrochemical conversions and are then cleaved from the carbon-containing material.